Having thus described the invention, we hereby claim:

1. An apparatus for adaptively predistorting a base-band signal having an in-phase component and a quadrature component, the signal being generated by a communication device, the apparatus comprising:

a clipping module operative to clip the base-band signal to produce a clipped signal;

a filter module operative to filter the clipped signal to eliminate high frequency components of the clipped signal and to produce a filtered signal;

a sampling module to increase the sampling rate of the filtered signal to obtain an upsampled signal;

an index calculating module operative to calculate index values based on the in-phase component and quadrature component of the base-band signal;

a look-up table having stored therein parameters, the parameters being retrievable based on the index values;

an output module operative to generate an output signal based on the parameters retrieved from the look-up table and the upsampled signal;

a receiver operative to retrieve samples of RF signals generated based on the output signals; and,

a processor operative to provide adaptive feedback to the look-up table based on the samples.

2. The apparatus as set forth in claim1 wherein the up-sampling module increases the sampling rate by a factor of four.

3. The apparatus as set forth in claim 1 wherein the index values are calculated by summing the squares of the inphase component and the quadrature component.

4. The apparatus as set forth in claim 1 wherein the index values are the instantaneous power envelopes of the base-band signals.

5. The apparatus as set forth in claim 1 wherein the parameters are derived from polynomial equations having coefficients.

6. The apparatus as set forth in claim 5 wherein the parameters are defined as A and B and the polynomial equations are as follows:

$$A = C_0 + C_1P + C_2P^2 + C_3P^3 \text{ for } A \leq A_m$$
$$A = A_m \text{ otherwise}$$
$$B = C_4P + C_5P^2 + C_6P^3 \text{ for } P \leq P_b$$
$$B = (B_{b1} - B_{b2}) + C_7P + C_8P^2 + C_9P^3 \text{ for } P > P_b$$

where $P = (I^2 + Q^2)$ is the instantaneous envelope power, A_m is a maximum value imposed on A to prevent the amplifier from being driven deep into saturation, P_b is a breakpoint where the B parameter transitions from one polynomial equation to the other, B_{b1} and B_{b2} are the values of B at $P = P_b$ using the first and second polynomial, respectively, and C_0 through C_9 are coefficients.

C1 Cont.

7. The apparatus as set forth in claim 5 wherein the adaptive feedback optimizes the coefficients.

8. The apparatus as set forth in claim 1 further comprising a delay module positioned between the sampling module and the output module.

Sub B2

9. A method for adaptively predistorting a base-band signal having an in-phase component and a quadrature component, the method comprising:

generating the base-band signal by a communication device;

clipping the base-band signal to produce a clipped signal;

filtering the clipped signal to eliminate high frequency components of the clipped signal to produce a filtered signal;

increasing the sampling rate of the filter signal to obtain an upsampled signal;

obtaining predistortion parameters;

outputting an output signal based on the predistortion parameters and the upsampled signal;

sampling RF signals generated based on the output signals; and,

providing adaptive feedback based on the sampling.

10. The method as set forth in claim 9 wherein the increasing of the sampling rate comprises increasing the sampling rate by a factor of four.

Sub B3

11. The method as set forth in claim 9 wherein the obtaining of the parameters includes calculating an index value by summing squares of the in-phase component and the quadrature component.

12. The method as set forth in claim 11 wherein the obtaining further comprises retrieving the parameters from a look-up table.

C1 cont.

13. The method as set forth in claim 9 further comprises deriving the parameters from polynomial equations having coefficients.

14. The method as set forth in claim 13 wherein the parameters are derived by defining the parameters as A and B and manipulating the polynomial equations as follows:

$$A = C_0 + C_1P + C_2P^2 + C_3P^3 \text{ for } A \leq A_m$$
$$A = A_m \text{ otherwise}$$
$$B = C_4P + C_5P^2 + C_6P^3 \text{ for } P \leq P_b$$
$$B = (B_{b1} - B_{b2}) + C_7P + C_8P^2 + C_9P^3 \text{ for } P > P_b$$

where $P = (I^2 + Q^2)$ is the instantaneous envelope power, A_m is a maximum value imposed on A to prevent the amplifier from being driven deep into saturation, P_b is a breakpoint where the B parameter transitions from one polynomial equation to the other, B_{b1} and B_{b2} are the values of B at $P = P_b$ using the first and second polynomial, respectively, and C_0 through C_9 are coefficients.

15. The method as set forth in claim 9 further comprising delaying input of the up-sampled signal to the output module.

16. A system for adaptively pre-distorting a base-band signal having an in-phase component and a quadrature component, the system comprising:

means for generating the base-band signal by a communication device;

means for clipping the base-band signal to produce a clipped signal;

means for filtering the clipped signal to eliminate high frequency components of the clipped signal to produce a filtered signal;

means for increasing the sampling rate of the filter signal to obtain an up-sampled signal;

means for calculating an index value based on the in-phase component and quadrature component;

means for retrieving parameters from a look-up table, the retrieving being based on the index values;

means for outputting an output signal based on the parameters retrieved from the look-up table and the up-sampled signal;

C1 Cont.

means for sampling RF signals generated based on the output signals; and,

means for providing adaptive feedback to the look-up table based on the sampling.

Sub B4

17. An apparatus for adaptively predistorting a base-band signal, the apparatus comprising:

a sampling module to increase the sampling rate of the signal to obtain an upsampled signal;

a module operative to calculate predistortion parameters;

an output module operative to generate an output signal based on the predistortion parameters and the upsampled signal;

a receiver operative to retrieve samples of RF signals generated based on the output signals; and,

a processor operative to provide adaptive feedback based on the samples.

18. The apparatus as set forth in claim 17 further comprising a clipping module operative to clip the baseband signal.

19. The apparatus as set forth in claim 18 further comprising filter module operative to filter the baseband signal after clipping.

C' cont.

20. The apparatus as set forth in claim 17 wherein the parameters are derived from polynomial equations having coefficients.

Add A'